# Exploring the Energy-Water Nexus

**February 25, 2005**
**NREL**
**Golden, CO**

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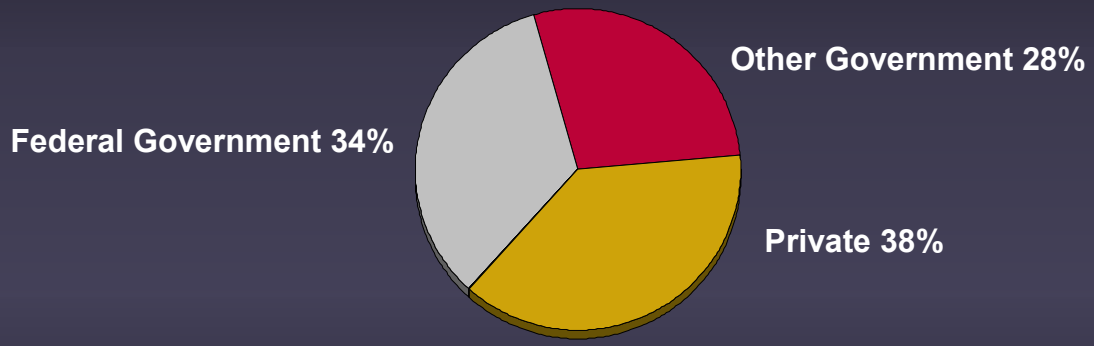
# Introduction to CH2M HILL

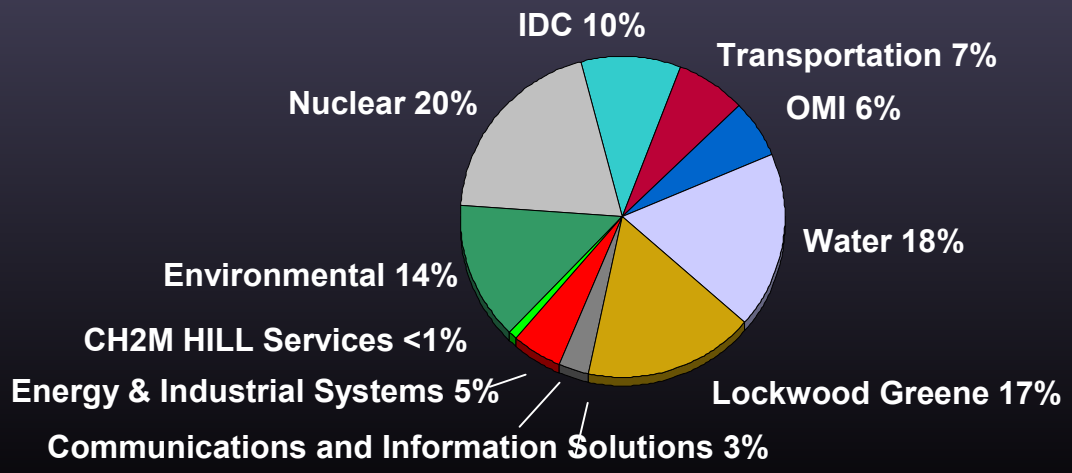
- One-stop project planning and design-build firm
  - We take any infrastructure project from concept to full operation
  - We manage infrastructure assets and environmental liabilities
- 58 years in business
- 100% employee owned
- Nearly 16,000 employees working in 65 countries worldwide
- $3.2 billion in revenue (estimated 2004)

# CH2M HILL's Diversified Business Base

## By Client Category




## By Business Line



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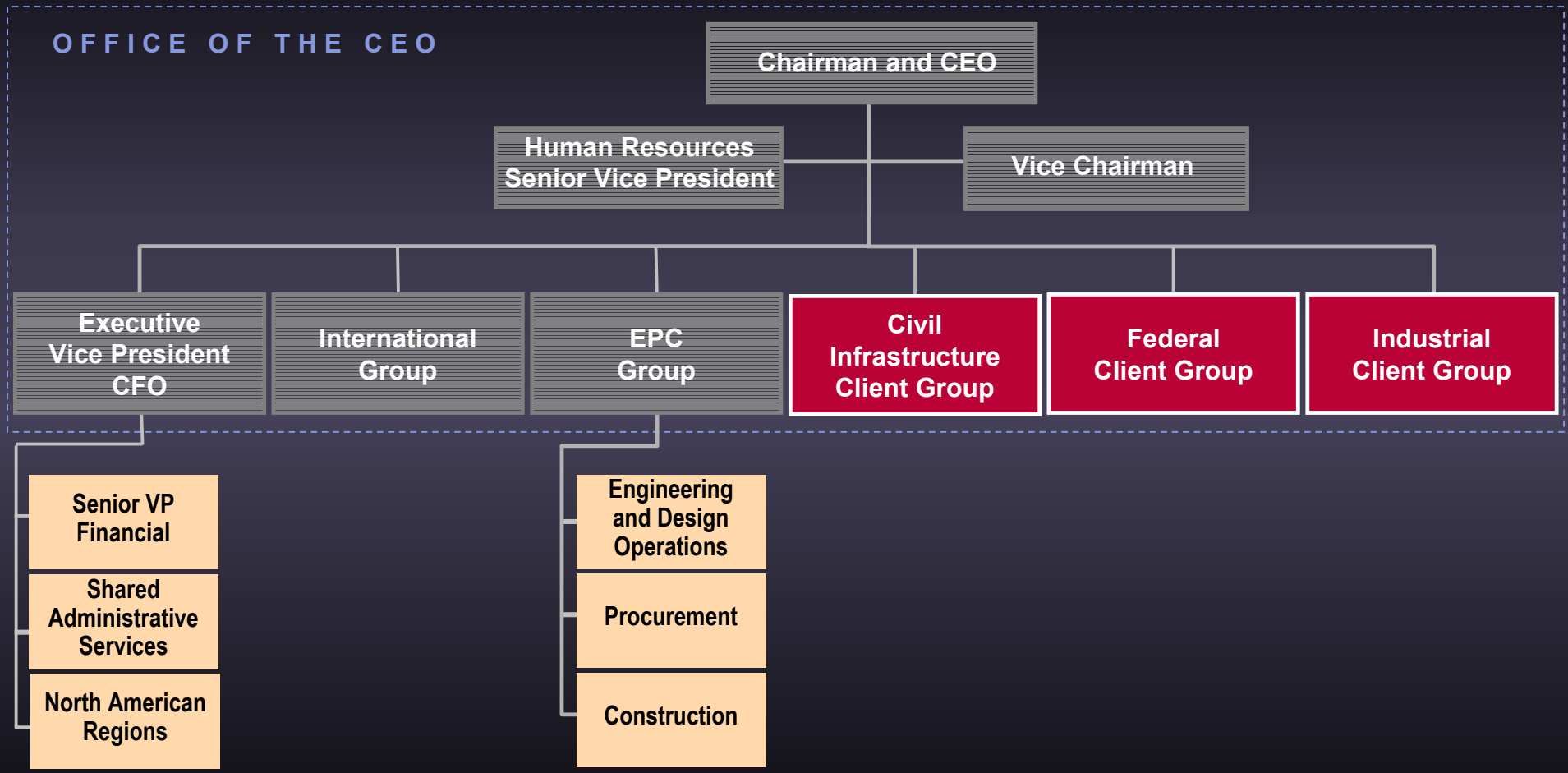
# Organizational Structure



# CH2M HILL's Three Major Client Groups

## Civil Infrastructure

- Water, Wastewater, and Water Resources
- Operations and Maintenance
- Transportation

## Federal

- Nuclear Services
- Environmental Services
- Military Facilities and Base Operations Support

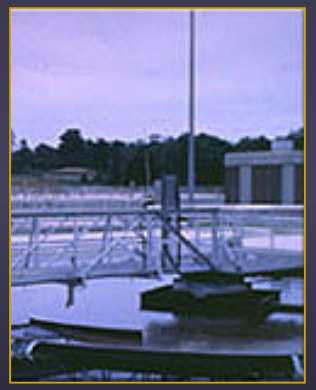
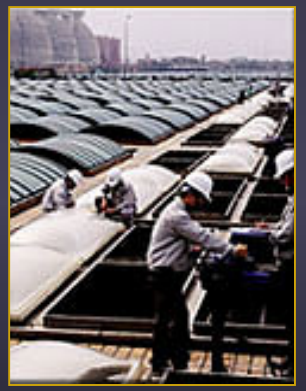
## Industrial

- Power and Energy
- Manufacturing
- Chemicals
- Pharmaceutical/ Biotechnology
- Electronics
- Communications and Information Systems

# Civil Infrastructure Client Group

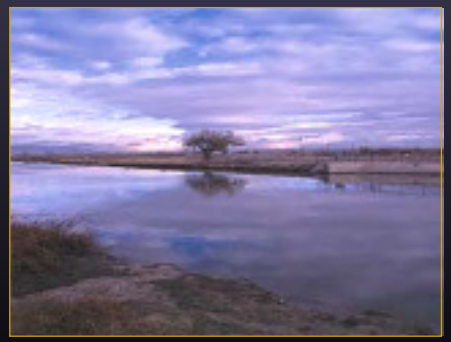
**Civil Infrastructure**

- Water, Wastewater, and Water Resources
- Operations and Maintenance
- Transportation

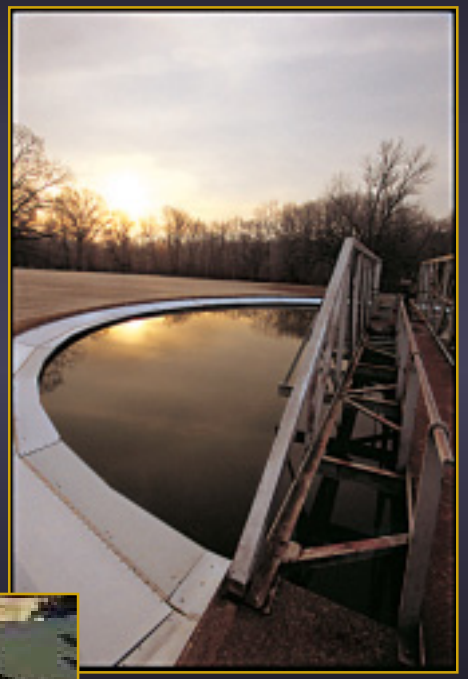
# Water, Wastewater, and Water Resources

- Water Storage, Transmission, Treatment, and Distribution
- Wastewater Collection, Conveyance, Treatment, and Disposal
- Water Resources/Watershed Management
- Wastewater Reclamation and Reuse
- Biosolids Management



# Operations and Maintenance

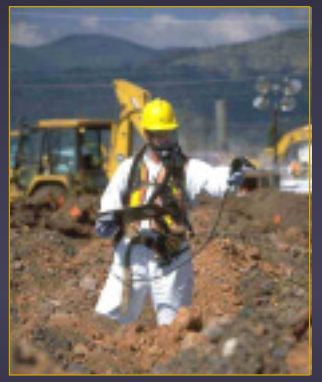
- Operations, Maintenance, and Management of Water/Wastewater Facilities
- Facility Startup and Performance Testing
- Full Operations Assistance
- Plant Efficiency Analysis
- Complete Public Works Management

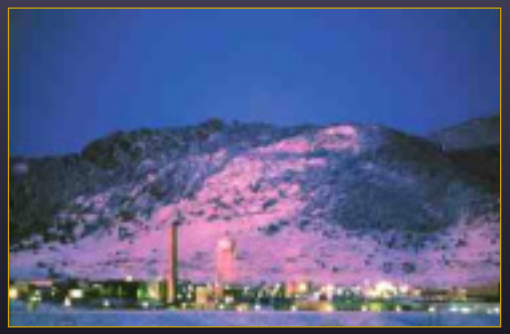


# Federal Client Group

**Federal**

- Nuclear Services
- Environmental Services
- Military Facilities and Base Operations Support





# Environmental Services

- Contaminated Site Assessment and Remediation
- Ecosystem Management and Restoration
- Air and Water Quality
- Solid and Hazardous Waste Management
- Facility Environmental Management Systems and Permit Compliance

# Industrial Client Group

**Industrial**

- Power and Energy
- Manufacturing
- Chemicals
- Pharmaceutical/ Biotechnology
- Electronics
- Communications and Information Systems

# Power and Energy Sector

- **Encompasses**
  - Clean Air Technologies
  - Coal
  - Cogeneration / CHP
  - Combustion Turbine
  - Conventional Steam Electric
  - IGCC
  - Renewable Technologies
  - Biogas
  - Wind
  - Wood Waste
  - Substation / Transmission
  - Wet / Dry Cooling Technologies
  - Repowering, upgrades, and modifications

- Technical Competencies
  - Power generation technologies
    - Coal, gas, and oil
    - Wind and other renewables
  - Substations and transmission
  - Clean air technologies
  - Cogeneration / CHP



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# CH2M HILL's Global Office Network

**130** in North America

**20** in Europe and the Middle East

**15** in Asia and the Pacific

**3** in Latin America

Note: Figures exclude temporary project offices, which more than double the number of locations where our people work at any given time.

# Market Drivers - Water

- O&M/Cost to Consumers
- Availability/Conservation
- Environmental Compliance
- Source, Cost & Reliability of Energy
- Security

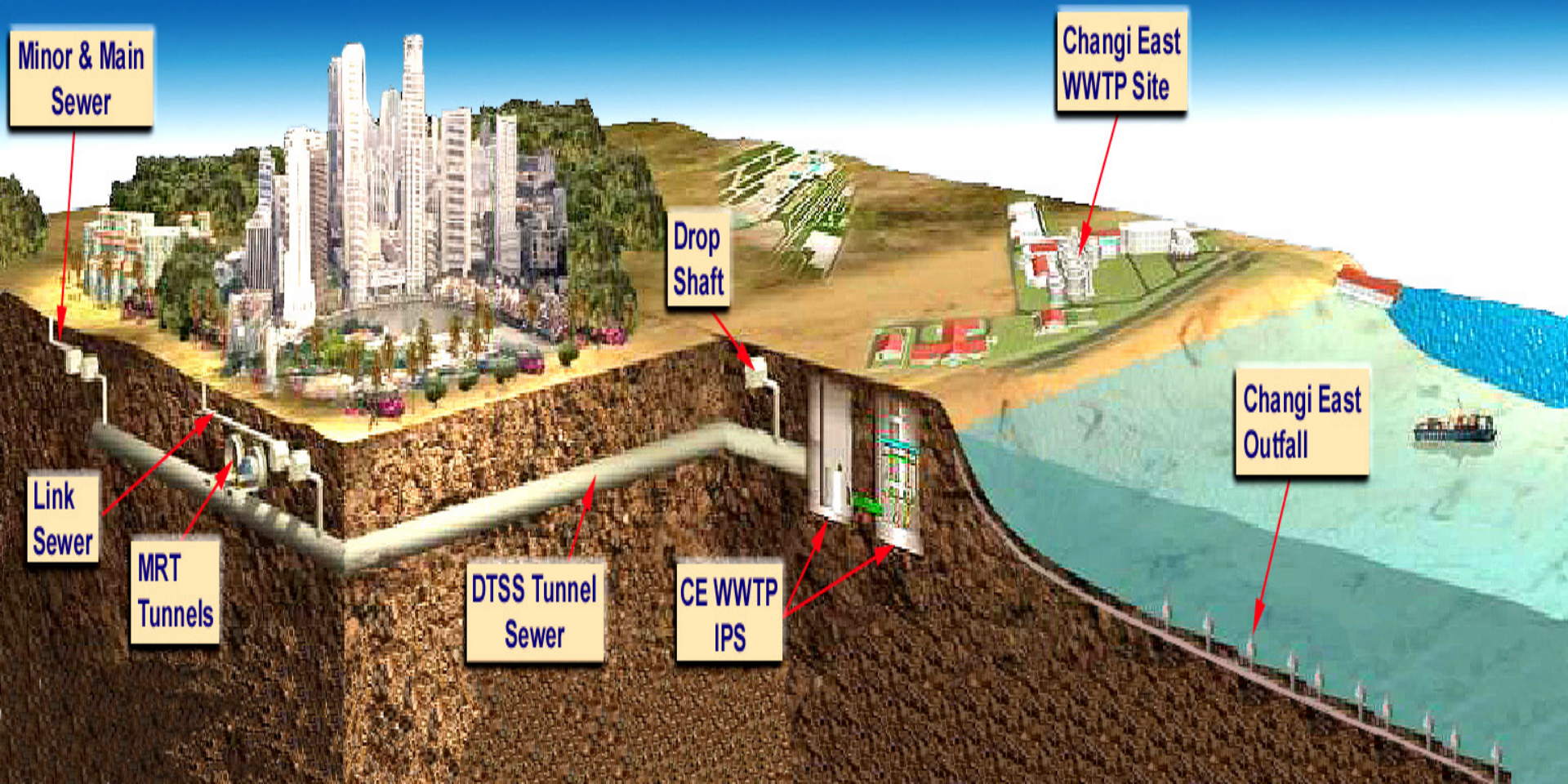
# Water – Colorado Springs Utilities

**Twin Rock Pump Station, Divide, Colorado**

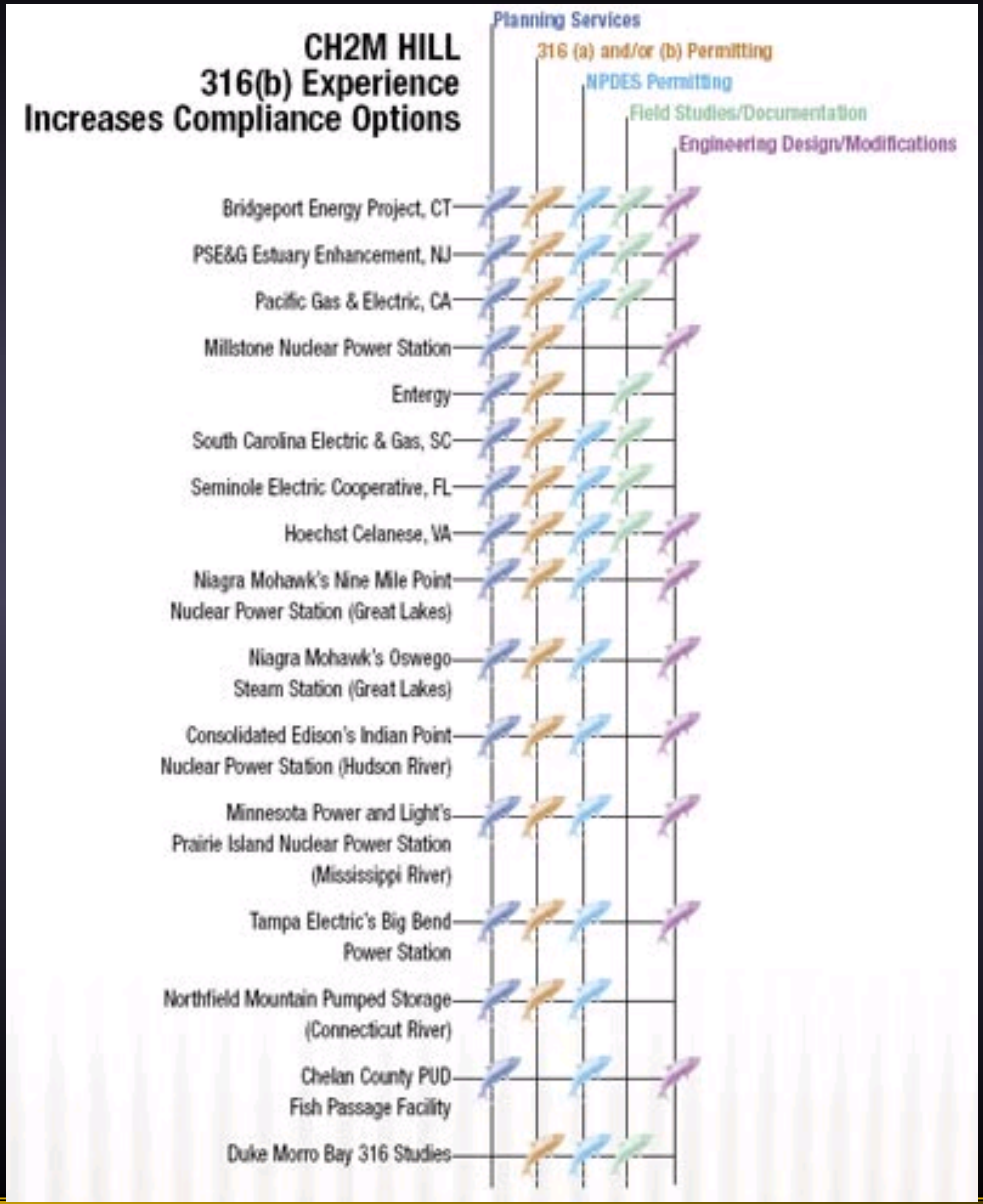
- Delivering 68 million gallons of raw water a day to Rampart Reservoir
- CH2M HILL project to upgrade Divide Pump Station -- saving $5 million
  - by building a new station at a new location; this also avoided pipeline construction in Florissant Fossil Beds National Monument.
- Rampart Reservoir was brought from 40 to 92 percent of capacity during the summer of 2002

LETTING GRAVITY DO THE WORK

# Water – Singapore Deep Tunnel Sewage System



# Water for Energy



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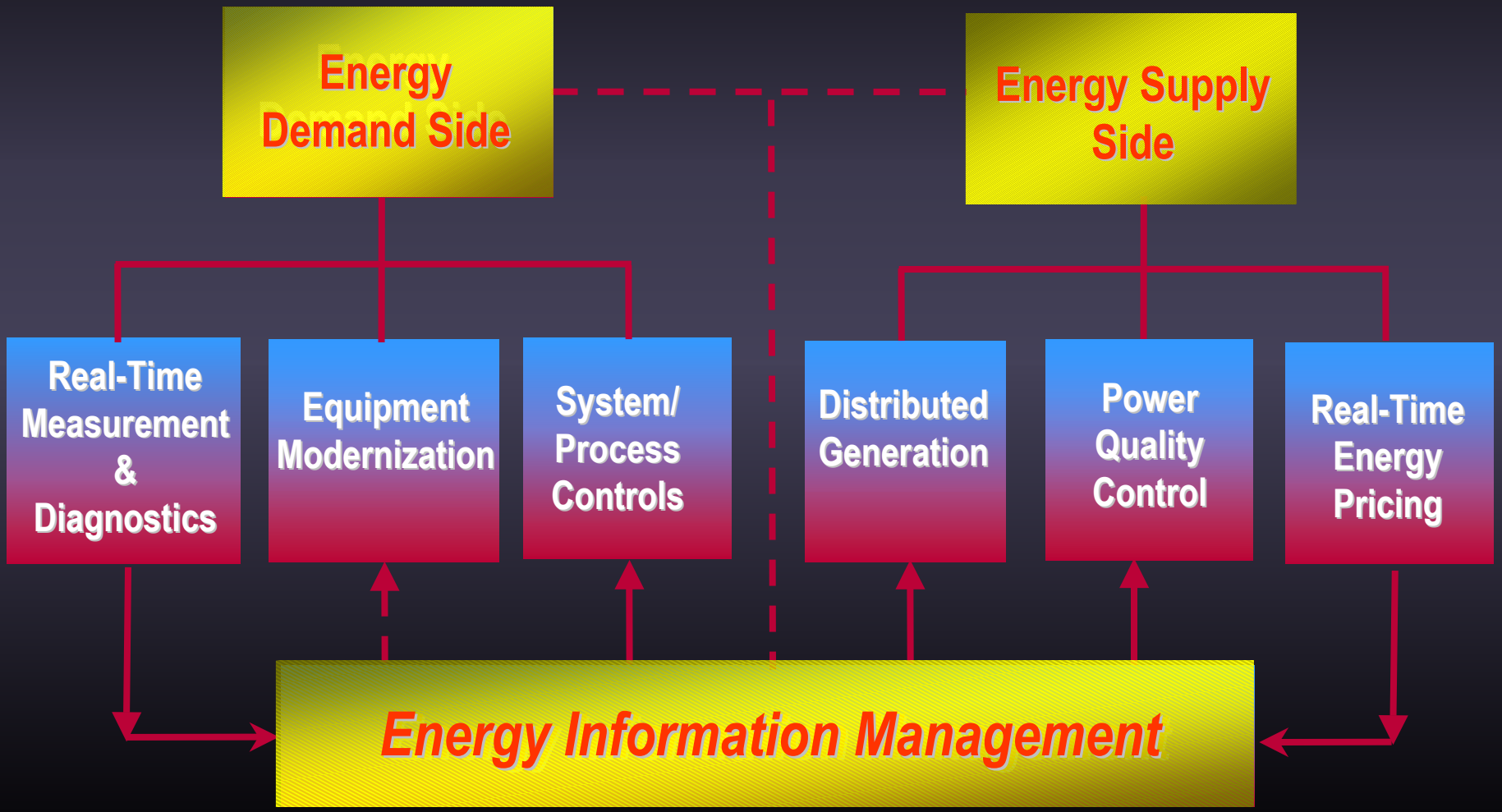
# Market Drivers - Energy

- Cost/Ownership
- Environmental Compliance
- Source, Cost & Reliability of Water
- Security
- Advanced Technology

# End User Sector

## Energy Information Management



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# Energy – Matching Power Generation to Municipal Utility Needs

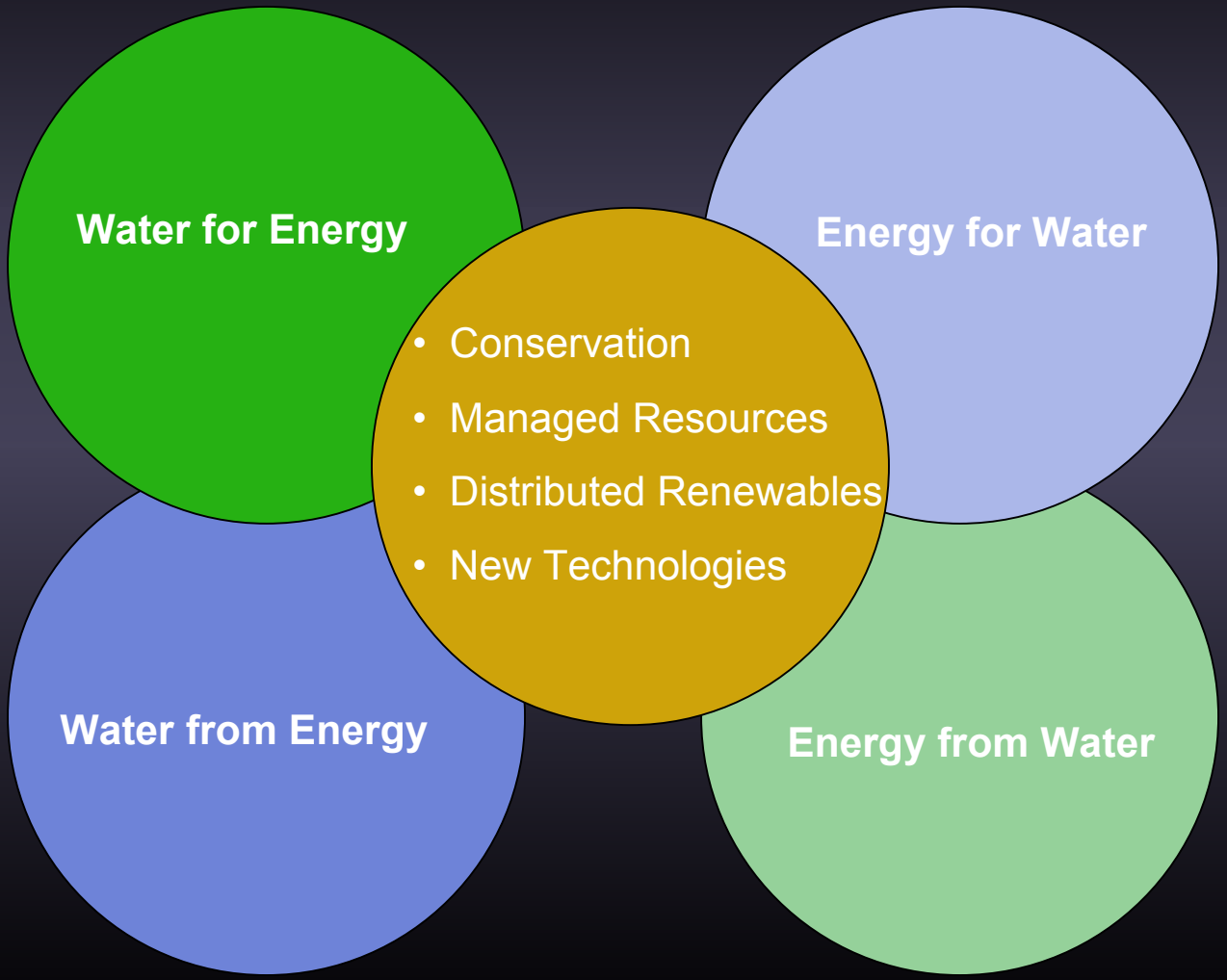
- City of Corona - Golden
  - Stand-alone cogeneration
  - Project development
  - 65 MW combined cycle project
- City of Corona - Clearwater
  - Cogeneration and sludge generation
  - Feasibility study/machine selection
  - 30 MW combined cycle project
- Pasadena Water and Power
  - 90 MW staged re-powering plan
  - 2 LM6000 simple cycle project

# Energy - Stateline Wind Project

- Largest single wind generation project in the world -- 300 MW
- Assistance with siting and layout
- Preparation of all environmental documentation and permits
- Key role in negotiating settlements with stakeholders/potential opponents
- Site civil design
- Services during construction

# The Nexus

## *Integrated Solutions*



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# Energy Water Integration
## Conservation

### *The Right Water for the Right Use*

#### *Denver Water Recycling Plant*

Colorado's arid climate and limited resources intensify the effect of drought, challenging such agencies as Denver Water, the state's largest drinking water supplier.

The Denver Water Recycling Plant treats secondary effluent from a nearby wastewater plant to a level suitable for irrigation and industrial uses. At full capacity, the plant conserves enough water to supply 35,000 households or the equivalent amount contained in a small reservoir.

Throughout all project phases innovative approaches and technologies amounted to multi-million-dollar savings. The plant itself is the only one of its kind in the world using biological aerated filtration technology for reclaimed water.

**Plant Superintendent** Brian Good was involved in every phase of the project and was even onsite for construction.

*"Startup of our Recycling Plant was the smoothest one in Denver Water history. We began at 7:00 a.m. and by 9:00 a.m. the plant was running so well that we sent home all the extra staff that had come in for the big event."*

BAF treatment cells biologically remove ammonia from influent water. Ammonia free water is required for the Xcel Energy's Cherokee Power Plant, visible in background.

The plant's distribution pump station, located on top of the onsite storage reservoir to reduce costs, delivers recycled water to customers, including Cherokee Power Plant, the Denver Zoo, and various schools, parks and lakes. The recycled water is delivered in purple pipes, the industry standard designating non-potable water.

CLIENT: Denver Water, Denver, Colorado
ENTERING FIRM: Boyle Engineering/CH2M HILL, Lakewood, Colorado
CATEGORY F: Water & Wastewater

BOYLE ENGINEERING CORPORATION
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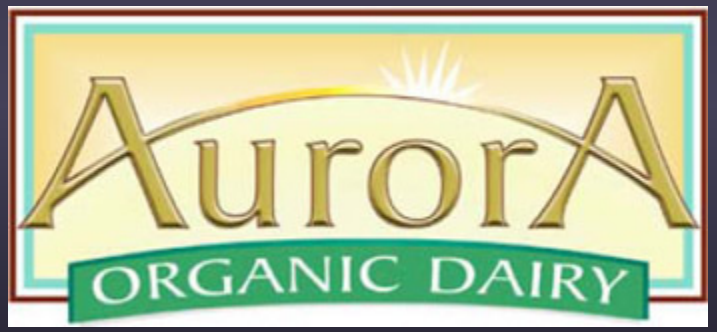
# Energy Water Integration
# Conservation/Managed Resources

## Aurora Organic Dairy, Boulder CO

- Project to begin in April 2005
- Similar clients have been able to save 22,000 gallons of water per day with aseptic filling systems, and an additional 40,500 gallons per day with water recovery systems
- We have also demonstrated ways to achieve $XX,000 per year in energy savings



# Energy Water Integration
# Managed Resources

## City of Toledo, OH

Water and power infrastructure vulnerability assessment

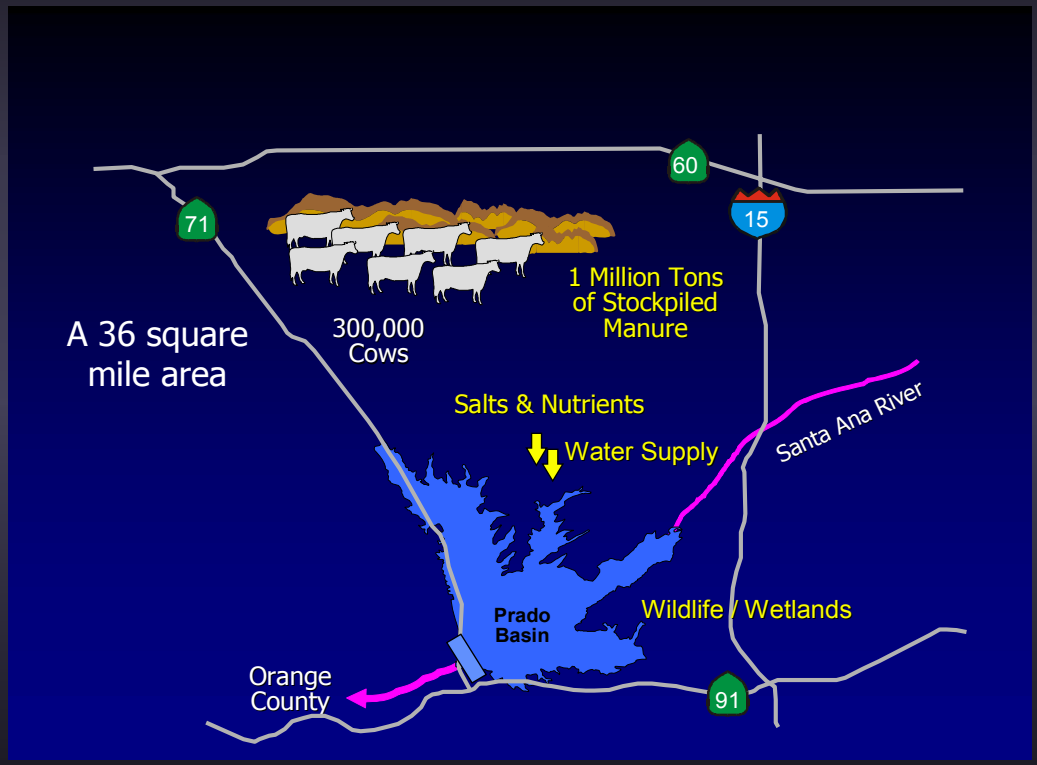
- Water Infrastructure
  - Reservoirs & Other Storage
  - Supply & Distribution Network
- Power & Communications Infrastructure
  - Power Generation
  - Power Supply & Distribution Systems
  - Mission-Critical Facilities (telecommunications, etc.)
- Other Hazards
  - Natural Gas and Product Pipelines
  - Power Generation Owned By Others

# Energy Water Integration
# Managed Resources/Distributed Renewables

## Chino Dairy Preserve

*An Energy Supply That Alleviates Urban Run-Off Issues*

- Prepared Energy Management Plan
- Preparing Energy Efficiency Evaluation and Digester Gas Cogeneration Implementation Plan



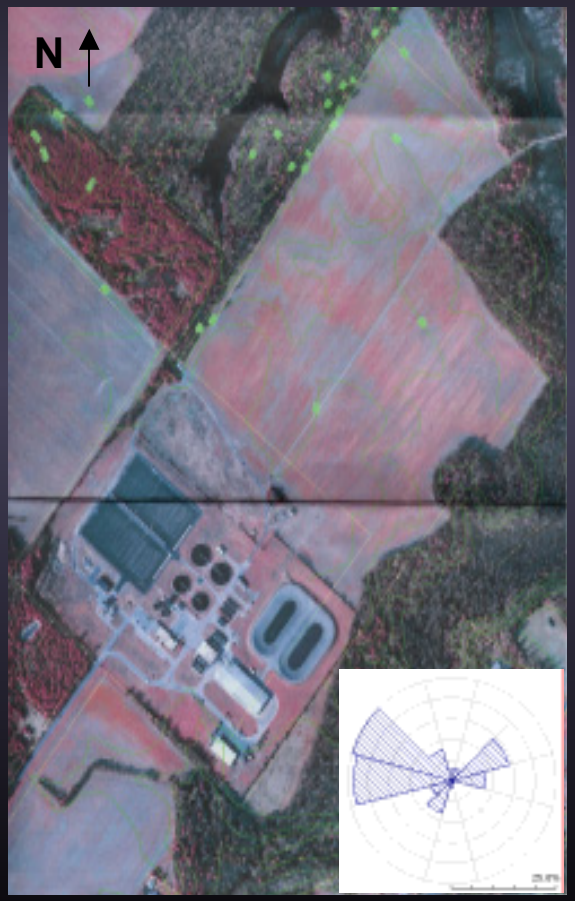
# Energy Water Integration
# Managed Resources/Distributed Renewables

## Cities of San Antonio, Austin, & Garland, TX

- Project Description
  - Utilize the natural production of biogas from waste water treatment facilities to generate power from internal combustion engines
  - Offer value added services across the entire energy supply chain
- Value Drivers
  - Economic power source
  - Improved power supply reliability
  - Power price volatility hedge
- Key Assets
  - CH2M Hill's waste water treatment process knowledge and experience
  - Reliant Energy's energy service knowledge and experience

# Energy Water Integration
# Distributed Renewables

- Field Survey
- Wind Resource Modeling
- Turbine Evaluations
- Energy Production Estimates
- Economic Analysis
- Funding Investigation
- Final Report and Recommendations



# Energy Water Integration
# Distributed Renewables

## California Energy Commission, Public Interest Energy Research (PIER) Renewable Energy Program

### Digester Gas Energy

- Inventory technical and market potential for renewable energy in Chino Basin, examine impacts on minigrid

- **Landfill bioreactor**
- **Sewage wastewater digestion**
- **Animal manure digestion**
- **Building integrated PV**



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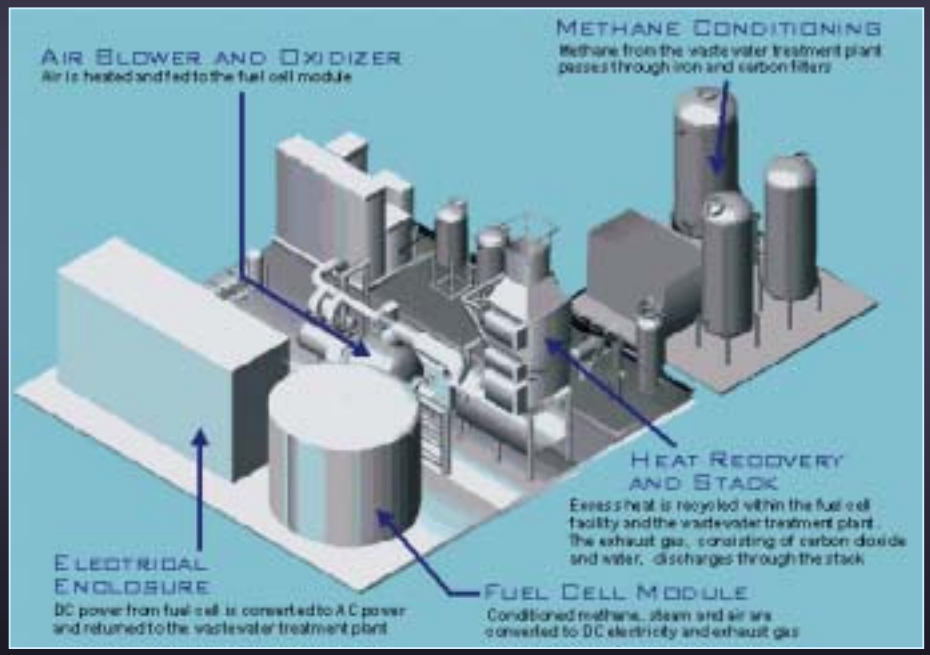
# Energy Water Integration
# New Energy Technologies

## Fuel Cell Demonstration Project

## King County, Washington

- Evaluated molten carbonate fuel cells (MCFCs) using digester gas for wastewater treatment plants in six cities



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## Energy Water Integration

# New Water Technologies

- Phytoremediation of Contaminated Soil and Groundwater
- Reuse of Municipal Wastewater and Biosolids
- Reuse of Industrial Wastewater and Byproducts
- Hybrid Poplar Applications
- Alternative Landfill Capping and Erosion Control
- Landfill Leachate Reuse
- Advanced Irrigation and Drainage Systems

# The Future Utility

- **Decentralized**
  - Reliability
  - Security
- **Integrated Services**
  (Electricity, Water, Communications)
  - Systems Integration
  - Shared Information Systems
- **Outsourced**
  - Optimized Design & Efficient Operation
  - Regulatory Compliance
  - Integrated Systems Management
- **Indigenous Fuel Source**
  - Reliability
  - Cost Control
- **Green**
  - Conservation Management
  - Environmental Stewardship



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# Areas for Additional R&D Emphasis

- Distributed Generation Technologies
- Desalination Technologies
- Integrated Utility System Designs
- Best Practices for Combined Energy/Water Conservation